

## **I. Introduction to Oceans**

- A. Oceanography – the application of the basic sciences to the study of the marine environment
- B. Formation of the ocean waters – water vapor and condensation of vapor as rain in the oceans basins

## **II. Water Cycle** - process by which water moves from ocean to land and back to the ocean again.

- A. Water cycle powered by solar energy
- B. Process of water cycle
  - 1. Evaporation – liquid water changes to gases
  - 2. Transpiration – water escapes from the leaves of plants
  - 3. Condensation – water vapor changes to a liquid
  - 4. Precipitation – liquid water is released from the atmosphere as rain, hail, sleet, or snow
  - 5. Runoff – water drains from the land and flows back into the ocean.

## **III. Oceans** – a continuous body of saltwater that covers approximately 70% of the Earth

- A. Pacific – largest, deepest, covers 1/3 of Earth's surface, contains approximately 1/2 of Earth's water
- B. Atlantic – second largest, contains Mediterranean, Caribbean and North Seas, shallower than Pacific and Indian
- C. Indian – deeper than Atlantic, shallower than the Pacific
- D. Arctic – surrounds the geographic North Pole

## **IV. Topography of Ocean Floor**

- A. Continental shelf – shallow-water platform that slopes gently from a continent to the deep ocean bottom.
- B. Continental slope – area of steeply sloping seafloor between the continental shelf and the deep ocean bottom.
- C. Submarine canyons – deep furrows cut into the continental slope.
- D. Abyssal plain – flat, almost level area in the deepest part of ocean basin.
- E. Seamounts – underwater volcanic mountains.
- F. Guyots – flat-topped, underwater mountains.
- G. Mid-ocean ridge – underwater mountain range that is the longest

topographic feature on the earth's solid surface.

H. Trench – a long, v-shaped channel located on the edges of the ocean basin, i.e., Marianas Trench and Aleutian Trench.

## **V. Properties of Ocean Water**

### **A. Composition of Ocean Water**

1.  $H_2O$  – 96.5%, other elements – 3.5%

2. Salinity – measure of the amount of chemicals dissolved in ocean water. As salinity increases, density increases.

### **B. Temperature of Ocean Water**

1. As temperature increases, density decreases.

2. Surface temperature – from 2°C (Arctic) to 28°C (equator).

3. Subsurface temperature – from 1°C to 3°C.

4. Thermocline – zone where there is a sharp difference in temperature between surface and deeper water.

C. Pressure – pressure increases as the ocean depth increases.

D. Color – natural color is blue, but can be affected by pollutants or microscopic plants.

## **VI. Waves and Wave Action**

A. Causes – wind and earthquakes

### **B. Characteristics of Waves**

1. Crest – highest point of wave.

2. Trough – lowest part of wave.

3. Wavelength – horizontal distance between crests or troughs.

4. Wave frequency – the number of waves that pass a point in a certain amount of time.

5. Wave height – the vertical distance from crest to trough.

6. Near shore, the wave height increases and the wavelength decreases.

C. Tsunami – wave caused by sudden shift in ocean floor.

## **VII. Tides**

A. Tides – movement of the oceans caused by the gravitational pull among the earth, sun, and moon.

1. High tides – occur twice a day, when the ocean water bulges as a

result of the gravitation pull of the overhead moon.

2. Low tides – occur twice a day, when the two areas of the earth are not experiencing high tides.
- B. Spring tide – tides that occur twice a month, at full and new moon, when the moon, earth, and sun are in a straight line.
- C. Neap tide – tides that occur twice a month, at first and third quarter moon, when the moon, earth, and sun form a right angle.

## **VIII. Currents and Climates**

### **A. Surface Currents**

1. Are driven by winds and can affect movement to a depth of several hundred meters.
  2. Either cool or warm the air above it influencing the climate of the land near the coast, i.e., Gulf Stream.
- B. Coriolis effect – apparent westward deflection of objects moving across the Earth's surface due to Earth's rotation.
- C. Deep currents – caused by differences in water density.
- D. Upwelling – upward movement of cold water from the ocean depths bringing organisms, minerals and nutrients to the surface.
- E. El Nino – unusual pattern of winds formed in the western Pacific that often brings severe or unusual weather conditions

## **IX. Life in the Ocean**

- A. Plankton – tiny organisms that float in the water and are carried by waves and currents.
1. Phytoplankton – plant plankton, i.e., diatoms.
  2. Zooplankton – animal-like plankton, i.e., protists, crustaceans.
- B. Nekton – free swimming life forms, i.e., larger fish, squid, sea turtles, whales.
- C. Benthos – bottom dwellers, both mobile and stationary, i.e. crabs, coral.

## **X. Ocean Zones**

- A. Neritic Zone – extends from the low tide line out to the edge of the continental shelf.
1. Receives sunlight and nutrients, contains most of the world's fishing grounds.
  2. Includes kelp forests and coral reefs.
- B. Open Ocean Zone – begins where neritic zone ends

1. Surface zone, approximately 200 meters, receive light.
2. Deep zone – dark, harsh area with few, highly adapted organisms and hydrothermal vents.

## **XI. Instruments of Investigation**

- A. SCUBA – Self-Contained Underwater Breathing Apparatus. Tanks of compressed air strapped on a diver's back and connected by hoses to a mouthpiece for breathing.
- B. SONAR – SOund Navigation And Radar. Method of mapping the ocean floor by transmission and reflection of sound waves.
- C. Geostationary operational environmental satellites (GOES) orbit the Earth at 22,000 miles. They are highly advanced observation platforms supplying detailed imagery of the Earth's oceans.
- D. Underwater laboratories - The *Aquarius* Underwater Laboratory is the only undersea laboratory dedicated to marine science operating in the world.  
*Aquarius* provides life support systems that allow scientists to live and work underwater, in reasonably comfortable living quarters, with sophisticated research capabilities.
- E. Deep ocean submersibles – Over the last few decades, engineers have developed submersible technologies capable of meeting the many challenges that the deep sea imposes upon explorers.